

Tutorial on ramping power supplies

A. Wehmann

NuMI Run Prep Session, 2/16/05
(updated 8/3/06)

Preview

- E38 parameter page – comments on PS control
 - Status bits illustration
- I14 Page – Control ramps
- Photo of 30 A Corrector supplies
- I68 Page – Calculate Ramps
 - Example ramps & ramp shape
 - Popup Windows Illustrated
- Camac Modules used in ramping

E38 - Parameter page

- On, Off, Reset
- Status indicators (e.g. tracking error)
- Digital status--Jump to S35 page & later return
- FTP--fast time plot
- “Knob” Trim Flattop values
 - E38, trms, subpage 1 has trim mults for NuMI-only mode
 - E38, trms, subpage 11 has trim mults for Mixed mode
 - Autotune is changing trim flattop values, dynamically
- View alarm status, limits

Status Bits Illustration

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General: CAMAC C453 module
Device Name:<E:HT114> Device Index:( 186557) Node:MI3 210 11 .

Basic Status Block:
SSDN(0000/0070/E501/0011)
default data size( 4) maximum data size( 4) atomic sz( 4)
Frequency Time Descriptor (FTD) ( 1 HZ) addr mode( 0)
raw status(000800F2) status text(DT)
on( NO ) ready( NO ) remote( ) positive( ) ramp( )
Basic Status PDB:
on attribute (00000100)(N) ready attribute (000000FF)(N)
remote attribute (No Attr)( ) polarity attribute(No Attr)( )
input data length( 4) ramp/DC attribute(No )
ON/OFF characters(ED)
REMOTE/LOCAL char( )
POS/NEG characters( )

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D80

E:HT114 MI65 Horz Trim @ 114

E38

0 * 0.074 Amps DT

E:HT114 MI65 Horz Trim @ 114

Stop/Continue Status --- Cont	0 bit-31	0 *On
bit-14	0 bit-30	0 *Off < D
bit-13	0 bit-29	0 *Reset < T
bit-12	0 bit-28	0 *Pol+
bit-11	0 bit-27	0 *Pol-
bit-10	0 bit-26	0
Calculation Error ----- No	0 bit-25	0 Alarm is
Ramp Enabled ----- No	0 bit-24	0 BYPASSED
Tracking Error Fault---- No	1 Add Table(s) Mode ----- Disable 0 Speech Is	
DC Overcurrent Fault---- No	1 Copy Table(s) Mode ----- Disable 0 BYPASSED	
Ground Fault----- No	1 Copy Time to H(i) Mode - Disable 0 Edit	
RMS Overcurrent Fault--- No	1 Data Archival Mode ----- Disable 0	
Low Input Voltage Fault- Yes	0 Ramp Down Mode ----- Enable 1	
External Permit Fault--- Yes	0 Copy Time to G(i) Mode - Disable 0	
Overtemp Fault----- No	1 Power Supply Off Mode -- Disable 0 New File	
Trip Summation Fault--- Yes	0 Stop/Continue Mode ---- Disable 0 Read File	

S53

Colors inverted to avoid black background

I14 Page - Control ramps

- Enable/Disable ramping
- Enable/Disable clock event
- View active ramp tables (choice of units)
 - NuMI bends & quads use interrupt level F, time table 6
 - Trims use interrupt levels E & F, time tables 5 & 6
 - Two interrupt levels allow for two versions of Autotune, one for Mixed-mode (E) and the other for NuMI-only (F)
 - 64 words per table, so F starts at $(5 \times 64) = 320$
 - Trims are simple ramp, e.g. F level flattop slots are 321 & 322
- Global device menu allows multiple device manipulations

I14 & Scale Factor

PA:I14 C4XX RAMP CONTROL<NoSets>

I14 CAMAC 400 Series Ramp Control
Device: E:H104 466, v1.60 MI3, C=73, S=16 Pgm_Tools

	# sf_1 * m_1 * f(t) + sf_2 * m_2 * g(M_1) + sf_3 * m_3 * h(M_2)	<	Clock Events	>
A	+	+	<	>
B	+	+	<	>
C	+	+	<	>
D	+	+	<	>
E	+	+	<	>
F	sf01 * 1 * f(t):06	+	< A5	>
G	+	+	<	>
H	+	+	<	>
I	+	+	<	>
J	+	+	<	>
K	+	+	<	>
L	+	+	<	>
M	+	+	<	>
N	+	+	<	>
O	+	+	<	>
P	+	+	<	>
Q	+	+	<	>

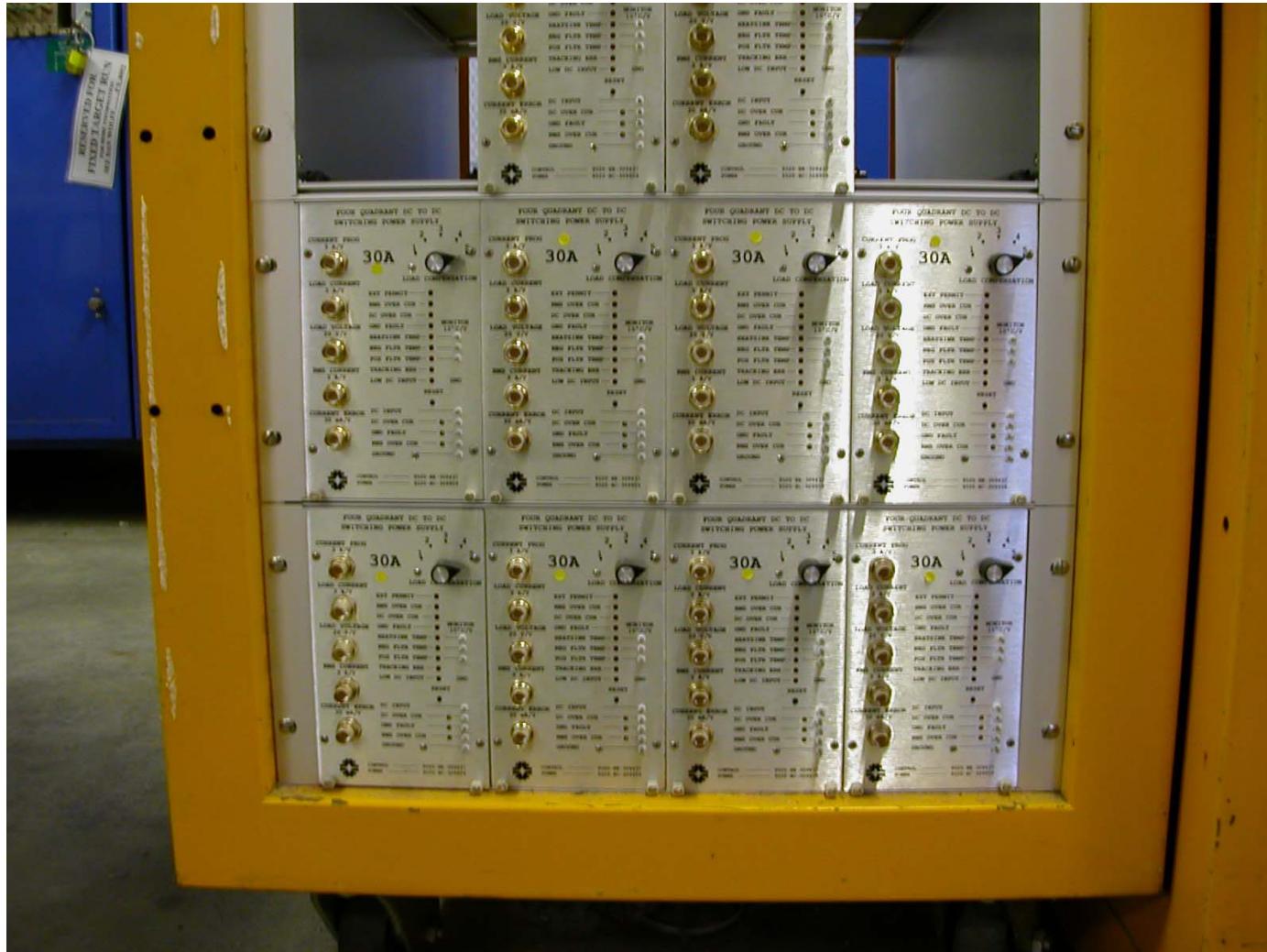
Scale factors are left fixed.

1:17 of 32 Messages

CNS#155 16:51:31 Completed validity checking
CNS#155 16:51:31 check scale factor * dependent table value
CNS#155 16:51:31 reading 6 FT tables

1: 3 of 11

Photo of 30 A Corrector Supplies



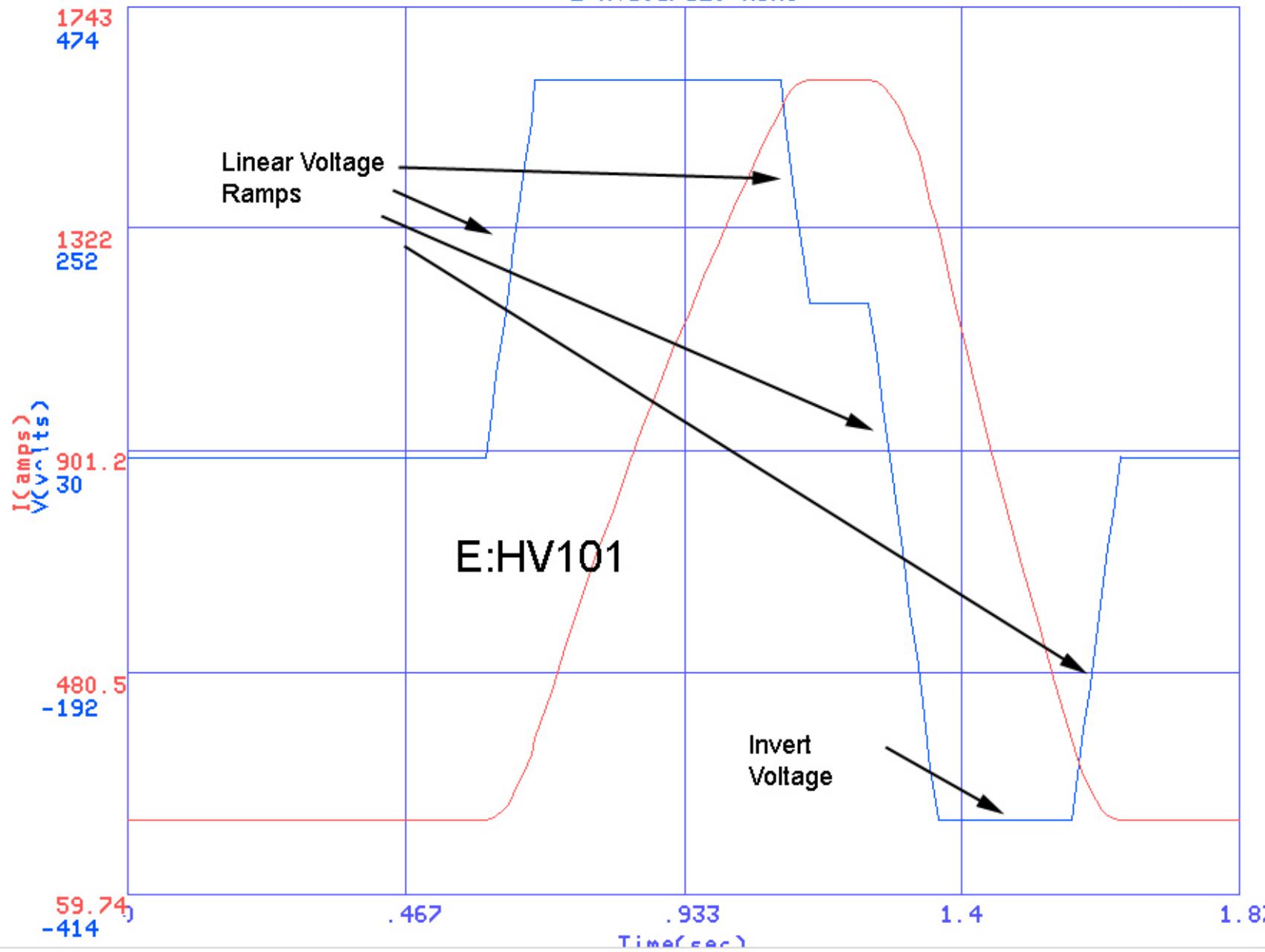
A bulk supply drives these switching units.

I68 - Calculate ramps

- Calculate ramp tables ("smooth" ramp)
- Send ramp tables to 46X ramp cards
 - *Ramp won't be sent by “Send One” if it hasn't been changed*
- Set clock event for ramp start & set flattop extraction time value (95 msec, 5 msec)
- Easy facility for changing flattop value
- local Save/Restore of ramp parameters
- Bends/Quads (not for trims)
 - E:H104 became E:HT104 (corrector supply)
 - **E:H104 is a device with no connected PS**
- Ramp shape not ideal for NuMI

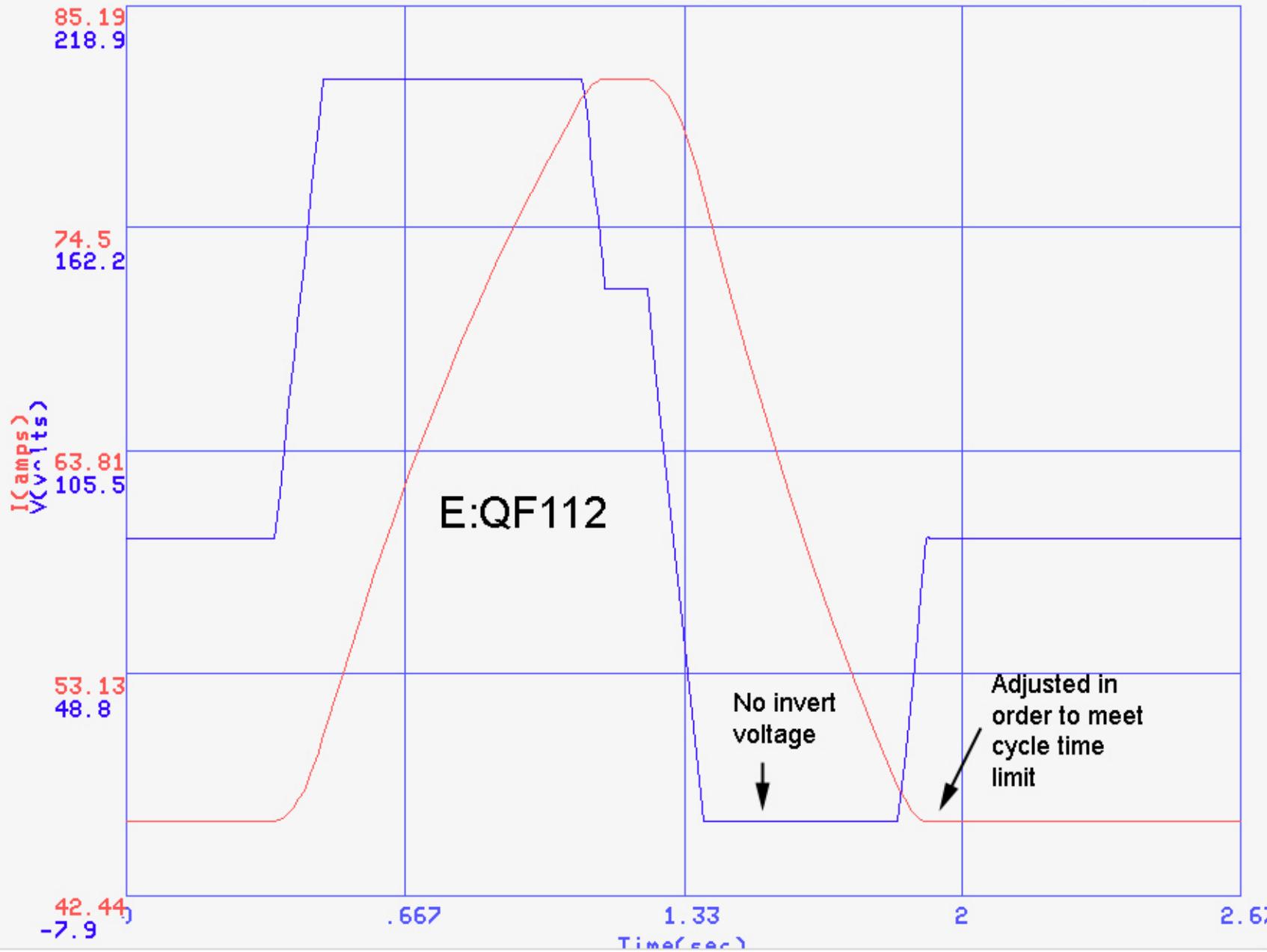
E:HV101/120 NuMI

02/05/05 1138



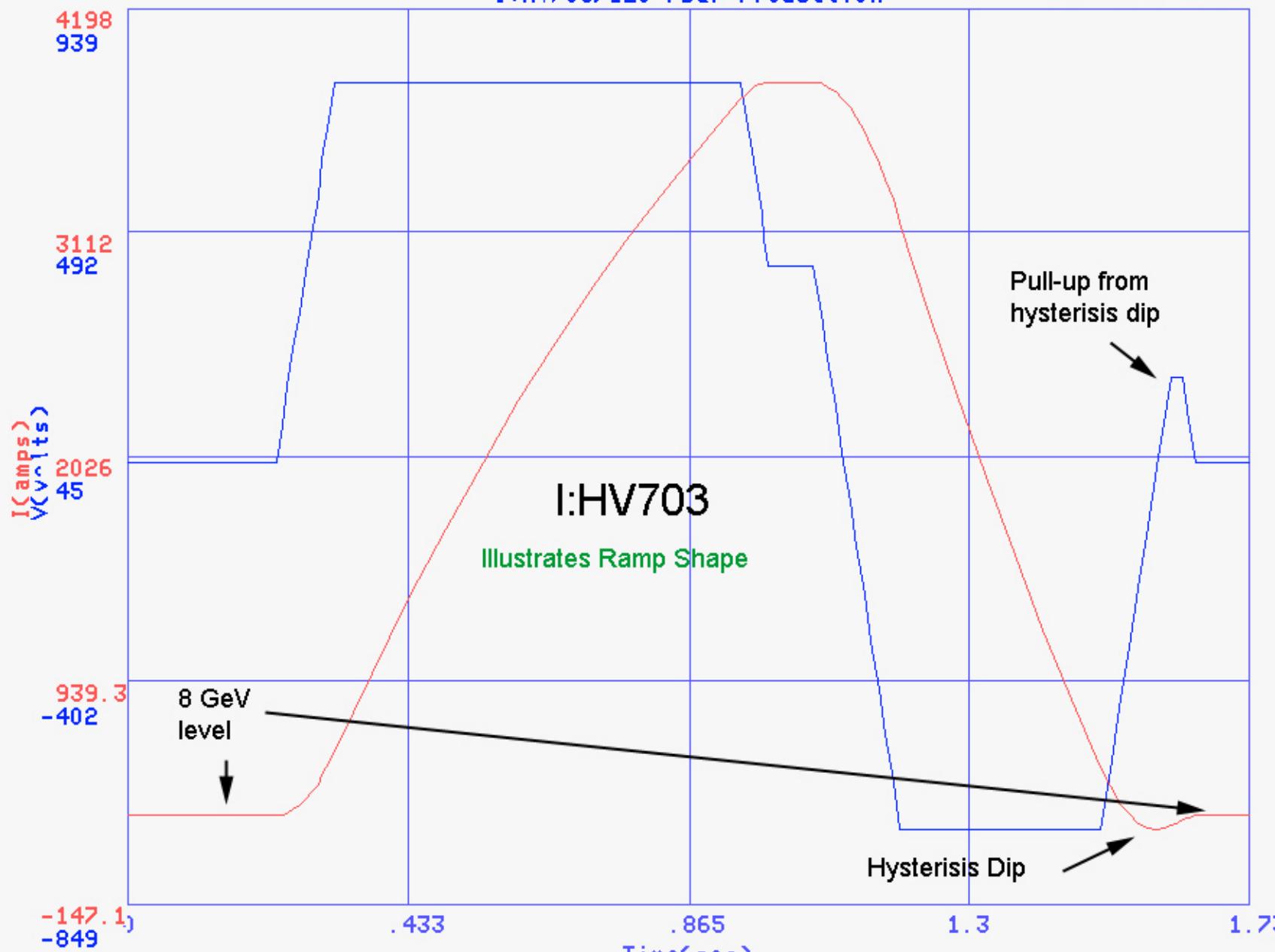
E:QF112/120 NuMI

02/05/05 1141

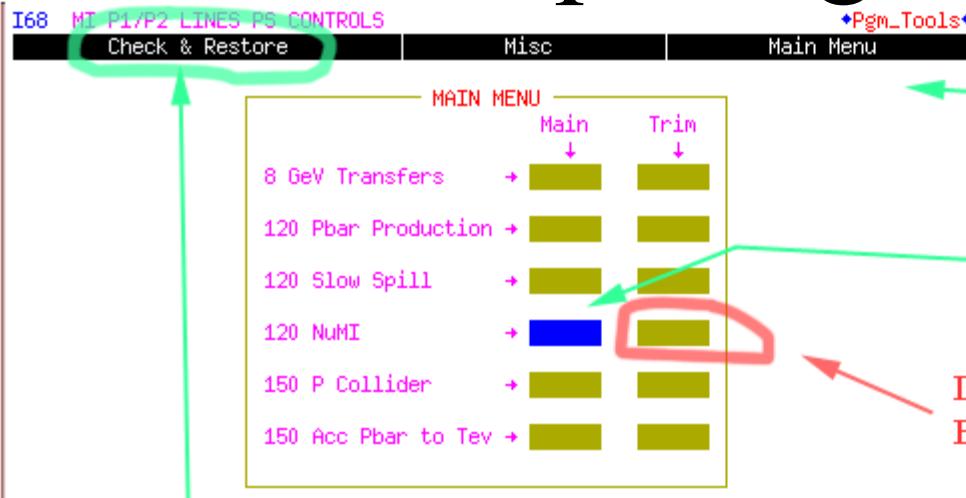


I:HV703/120 Pbar Production

02/05/05 1129



I68 Opening Screen

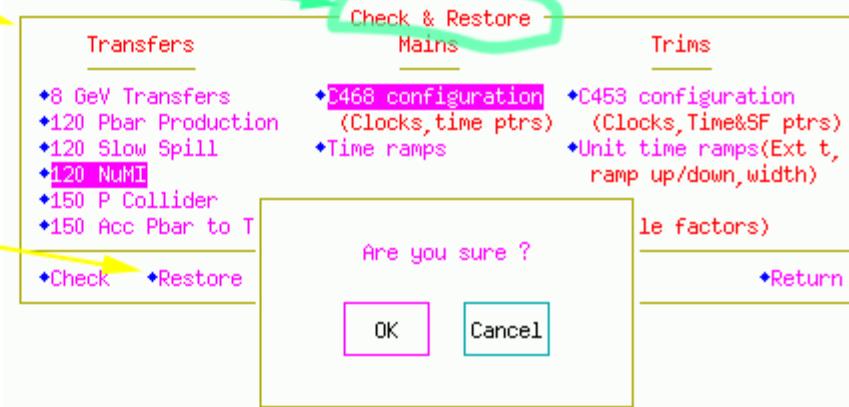


This is the screen seen when I68 is first invoked. The normal next step for NuMI is to mouse click at "120 NuMI", "Main" (tab shown highlighted in the color blue).

Don't Use "Trim" Button

Check & Restore is useful for looking for and correcting problems--e.g. a ramp card in a crate that lost its ac power.

This window appears if the user mouse clicks on "Check & Restore". If one highlights the choices as shown and mouse clicks on *Restore, then the confirmation window appears. The *Restore uses the active file and sends to the ramp cards



Normally the Active File.
Changes sent to the ramp
cards are saved in it

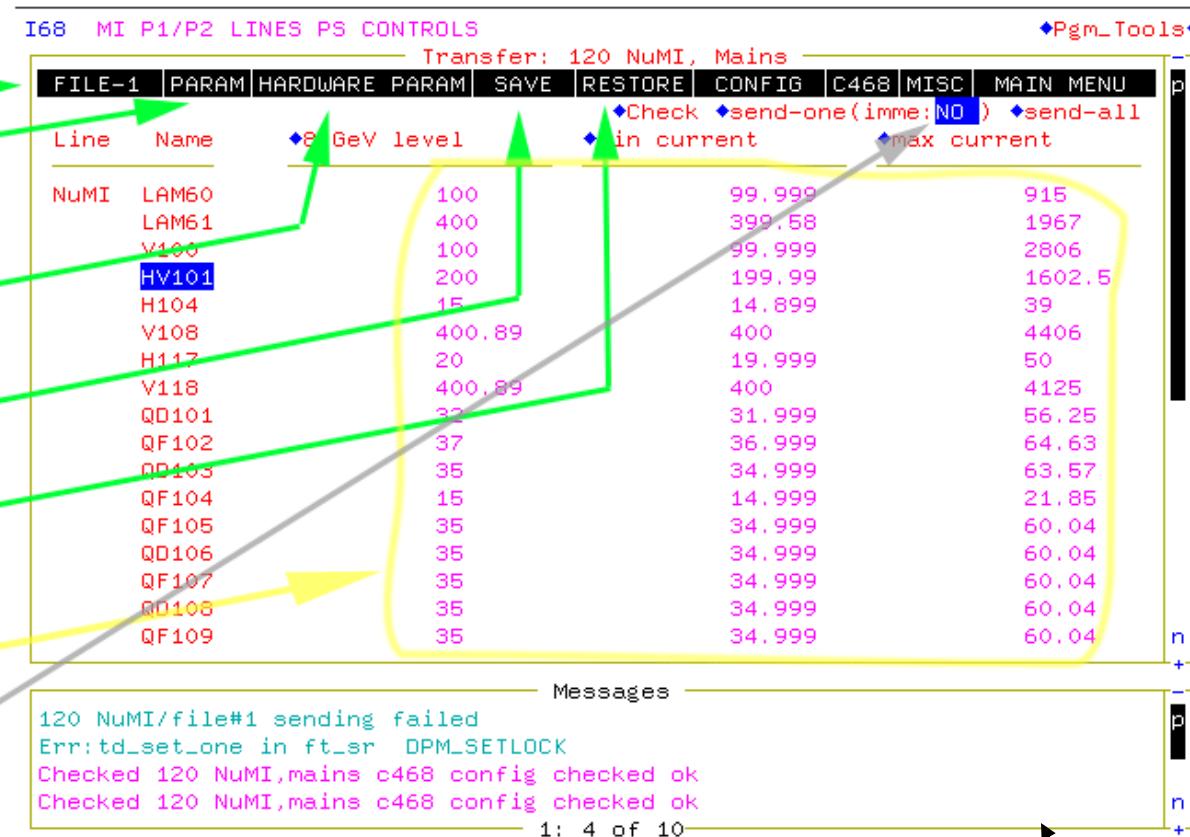
View/change the ramp
parameters/plot ramp

View/change the physical
parameters of the magnet
& circuit

Save parameters to a
file

Restore to session start
conditions--sends to ramp cards
(currently without any confirmation)

~~Changes made to these
numbers are sent to the ramp
cards immediately if immedi-
ate send is “Yes”.~~



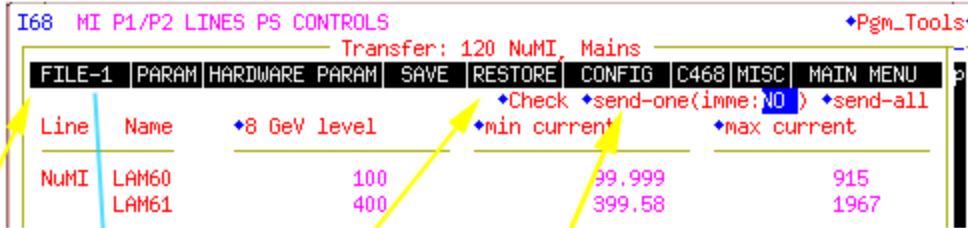
A file dialogue similar to that shown below is used to select a file, save
to a file, or copy one file to another.

Transfer 120 NuMI, Select a File

No.	title	Date-saved	Date-sent
		♦Date-sent	♦Return
1	\$AD ramp start, ramps 2.4 s	05/15/06 1557	07/31/06 1526
2	2/23/06 as founds	02/23/06 0706	02/28/06 1724
3	Final tune used 21:00 4Dec04 gmk	12/04/04 2110	12/02/04 1816
4	test 8	04/20/06 1248	04/20/06 1327
5	2/23/06 ramps lengthened to >=2.4s	02/23/06 0703	05/15/06 1542
6	copy of file 1 for test	05/05/06 0927	04/20/06 1629
7	\$AD ramp start, ramps 2.4 s(copy)	07/28/06 1557	05/15/06 1558

I68-Main
Working
Screen

Concept of Active File – I68



Normally the Active File: Changes made to parameters and sent to ramp cards are saved in the active file. RESTORE will reset the active file back to how it was at the start of the session. It will also restore the ramp card tables to what they were at the start of the session. A new file can be selected, but isn't active until it has been sent to the ramp cards. An attempt to do “send one” from an inactive file will result in an error window.

Transfer 120 NuMI, Select a File				
No.	title	Date-saved	Date-sent	
		*Date-sent	*Return	
1	\$AD ramp start, ramps 2.4 s	05/15/06 1557	07/31/06 1526	
2	2/23/06 as founds	02/23/06 0706	02/28/06 1724	
3	Final tune used 21:00 4Dec04 gmk	12/04/04 2110	12/02/04 1816	
4	test 8	04/20/06 1248	04/20/06 1327	
5	2/23/06 ramps lengthened to >=2.4s	02/23/06 0703	05/15/06 1542	
6	copy of file 1 for test	05/05/06 0927	04/20/06 1629	
7	\$AD ramp start, ramps 2.4 s(copy)	07/28/06 1557	05/15/06 1558	

Not allowed to send to one ps from an in-active file

OK

I68 Popup Windows--

Example I

I:LAM60/120 NuMI	
RESTORE	RETURN
ramp parameters	calc
convert 1 volt	40
invert 1 volt	40
convert 2 volt	2.35
max dV/dt	420
ramp length	1.8666
flat-top start dt	.095
flat-top end dt	.005
t_rest	.001
8 GeV level	100
min current	99.999
max current	915
extractn time(*timer)	1.2401
*steps in segments(sum < 64)	
*hardware parameters	

Parameter Window: Used to change ramp parameters.
 Changes can be “restored” to session start conditions.
 Extraction time can be temporarily set, for purposes of calculating and plotting a ramp, but is determined by extraction timer in practice.

*Check does a check of file contents versus what is in the ramp cards. The MISC menu has been augmented (8/06) to allow a visual check (see two slides later).

I68 MI P1/P2 LINES PS CONTROLS					
Transfer: 120 NuMI, Mains					
FILE-1		PARAM	HARDWARE PARAM	SAVE	RESTORE
Line	Name	*8 GeV level			
NuMI	LAM60	100			
	LAM61	400			
			*min current		*max current
			99.999		915
			399.58		1967

I:LAM60 (same for all cycles)			
READ	SAVE	RESTORE	RETURN
max convert volt	50		
max invert volt	40		
max ps current	1000		
inductance	.018		
resistance	.023		

Hardware parameters for a power supply. Are used in calculating ramp. “Restore” undoes session changes.

Transfer 120 NuMI, Select a File				
No.	title	Date-saved	Date-sent	
		*Date-sent	*Return	
1	\$AD ramp start, ramps 2.4 s	05/15/06 1557	07/31/06 1526	
2	2/23/06 as Founds	02/23/06 0706	02/28/06 1724	
3	Final tune used 21:00 4Dec04 gmk	12/04/04 2110	12/02/04 1816	
4	test 8	04/20/06 1248	04/20/06 1327	
5	2/23/06 ramps lengthened to >=2.4s	02/23/06 0703	05/15/06 1542	
6	copy of file 1 for test	05/05/06 0927	04/20/06 1629	
7	\$AD ramp start, ramps 2.4 s(copy)	07/28/06 1557	05/15/06 1558	

Save files can be used for multiple purposes. For example, ramp parameters can be modified and saved to a file for sending to the ramp cards at some future date (an example is this file).

I68 MI P1/P2 LINES PS CONTROLS				
Transfer: 120 NuMI, Mains				
FILE-1 PARAM HARDWARE PARAM SAVE RESTORE CONFIG C468 MISC MAIN MENU				
Line	Name	+8 GeV level	*min current	*max current
Numi	LAM60	100	99.999	915
	LAM61	400	399.58	1967

♦Pgm_Tools♦

Edit Configuration - Mains c468				
READ	SEND TO C468	CHECK C468	RESTORE	RETURN
	Transfer	Extract	Interrupt	f(t)
#	name	Timer	Level	Events
	*get			
1	8 GeV Transfers	I:MIAX	A	♦ 1
2	120 Pbar Production	I:MIPBTX	B	♦ 2
3	120 Slow Spill	I:MIBLX	C	♦ 3
4	120 NuMI	I:MINX	F	♦ 6
5	150 P Collider	I:MITCPX	D	♦ 4
6	150 Acc Pbar to Tev	I:MITPBX	E	♦ 5

 Plot Options
 plot calc curr&voltage [TRUE]
 plot snapshot current [TRUE]
 plot snapshot voltage [TRUE]
 snapshot frequency(Hz) [200]
 snapshot tclk prefered [00000008E]
 Return

Plot Options
 Copy Files
 Card-File Data

New as of 8/06--see next page

C468(for main ps) Config		
Read	Send	Return
Channel:I:LAM52	*status: DIS	
Main MDAT:(G)M 0 (H)M10	Pointors:	
Level ——Clocks:	F(t) G(i) H(i) sf1 sf2 sf3	
↑ 0	93 85 9A FE FE FE FE	1 0 0 1 0 0
1	8E FE FE FE FE FE FE	2 0 0 1 0 0
2	30 FE FE FE FE FE FE	3 0 0 1 0 0
3	2B FE FE FE FE FE FE	4 0 0 1 0 0
4	FE FE FE FE FE FE FE	0 0 0 0 0 0
5	FE FE FE FE FE FE FE	6 0 0 1 0 0
6	FE FE FE FE FE FE FE	0 0 0 0 0 0
7	FE FE FE FE FE FE FE	0 0 0 0 0 0
8	FE FE FE FE FE FE FE	0 0 0 0 0 0
9	FE FE FE FE FE FE FE	0 0 0 0 0 0
10	FE FE FE FE FE FE FE	0 0 0 0 0 0
↓11	FE FE FE FE FE FE FE	0 0 0 0 0 0
*GII:♦ *HII: *ScaleFactor:		

Select a transfer to Copy from
 (Click on one cycle to select)

#	Transfer name	Extract	Interrupt	f(t)
	*get			
1	8 GeV Transfers	I:MIAX	A	♦ 1
2	120 Pbar Production	I:MIPBTX	B	♦ 2
3	120 Slow Spill	I:MIBLX	C	♦ 3
4	120 NuMI	I:MINX	F	♦ 6
5	150 P Collider	I:MITCPX	D	♦ 4
6	150 Acc Pbar to Tev	I:MITPBX	E	♦ 5

I68 Popup Windows--
 Example II



New I68 Features--as of 8/06

Transfer 120 NuMI, Select a File

No.	title	Date-saved	Date-sent	Return
1	\$AD ramp start, ramps 2.4 s	05/15/06	1557	07/31/06 1526
2	2/23/06 as founds	02/23/06	0706	02/28/06 1724
3	Final tune used 21:00 4Dec04 gmk	12/04/04	2110	12/02/04 1816
4	test 8	04/20/06	1248	04/20/06 1327
5	2/23/06 ramps 1		0703	05/15/06 1542
6	copy of file 1		1927	04/20/06 1629
7	\$AD ramp start,		1557	05/15/06 1558

Select a file for sent-times

OK

Clicking here highlights this control and allows for selecting a file and examining when PS ramps were sent from that file

120 NuMI/Fid=7: sent-times

PS	Date-sent	Return
I:LAM60	15-MAY-2006 15:58:19	
I:LAM61	15-MAY-2006 15:58:19	
E:V100	15-MAY-2006 15:58:19	
E:HV101	05-JUN-2006 07:11:01	
E:H104	15-MAY-2006 15:58:19	
E:V108	15-MAY-2006 15:58:19	
E:H117	15-MAY-2006 15:58:19	
E:V118	15-MAY-2006 15:58:19	
E:QD101	15-MAY-2006 15:58:19	
E:QF102	15-MAY-2006 15:58:19	
E:QD103	15-MAY-2006 15:58:19	
E:QF104	15-MAY-2006 15:58:19	
E:QF105	15-MAY-2006 15:58:19	
E:QD106	15-MAY-2006 15:58:19	
E:QF107	15-MAY-2006 15:58:19	
E:QD108	15-MAY-2006 15:58:19	

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Plot Options
Copy files
Card-File Data

A third line was added to this menu. It allows one to compare the contents of the active file vs the ramp card tables.

Card(E:H104) - file ramp data comparision

#	Card-t	file-t	Dif-t	Card-i	File-i	Dif-i	Return
0	1	1		9830	9830		
1	8955	8955		9830	9830		
2	66	66		9862	9862		
3	66	66		9959	9959		
4	66	66		10120	10120		
5	66	66		10343	10343		
6	66	66		10627	10627		
7	66	66		10973	10973		
8	66	66		11379	11379		
9	66	66		11844	11844		
10	66	66		12367	12367		
11	66	66		12948	12948		
12	93	93		13794	13794		
13	93	93		14623	14623		
14	93	93		15437	15437		
15	93	93		16235	16235		
16	93	93		17018	17018		
17	93	93		17785	17785		
18	93	93		18538	18538		

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Camac modules

- 453, quad unit for correctors, shared bulk supplies
- 466 for quads, H117
- 468 for big bends